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he could bear misfortune with equanimity, but to the close of life readily participated in the cheerful amusements of society; devotedly fond of study, and having untiring industry and a retentive memory, his mind was richly stored with all the knowledge that literature could impart; fond of scientific investigations, so far as his many engagements permitted him to pursue them, he readily gave his aid to those who engaged in them; actively benevolent, he was unceasing in his endeavours to promote every plan which he deemed conducive to the welfare or improvement of men. In his profession he was eminently distinguished; as an advocate and a lawyer, he stood by general consent in the highest rank; and his labours in those kindred branches of study and reflection, which were required in the preparation of the systems of civil and criminal law which he framed, gave him a reputation, and secured to him honours and distinction in his own and other countries, not surpassed by any of the jurists of his times. Among the statesmen of America his place was no less eminent; his public speeches present in every instance striking views of the questions he discussed, and although the stations of trust to which he was elevated place his official labours in comparison with some of the most illustrious of his countrymen, this has only served to display more clearly their intrinsic merit, and to secure for them an equal approbation.

SPECIAL MEETING.

Fourth Session, 27th May, half past 7 o'clock, P. M.

Dr. Bache, Vice-President, in the Chair.

A letter was received from Dr. John Locke, of Cincinnati, Ohio, containing a brief notice of the method which he had adopted for replacing the cross hairs in the telescope of a transit instrument.

Dr. Locke remarks, that though this method may not be new to instrument makers, the description may be of service to amateurs who are at a distance from such aid. Dr. Locke used the threads taken from a spider's cocoon. The points to be accomplished were to stretch the line to a perfect tension in a manageable way, to re-

move from it the flexuosities of the cocoon, and to adjust the lines parallel to, and equidistant from, each other. The first condition was answered by fastening the thread with wax between the ends of an elastic wire, bent in the form of the letter U, and the ends of which were made to approach each other, slightly, by a wooden clamp. The line was straightened by holding it, while under tension, above a vessel of boiling water. Each line in turn, while still stretched, was put in place by the lines engraved upon the diaphragm, verified by a micromoter microscope and fastened by varnish. In the final placing of the lines a small wire, sliding by means of a fine screw, was used to change slightly the place of the several fibres. Dr. Locke states that he has had a diaphragm made with adjustible fibres, so as to avoid any error in the intervals. The fibres are fixed at one end only, and are brought into position by resting in their course across the plate upon oval pins, which can be turned by square heads formed upon them.

A communication "On the Launch of the Three-deck Ship, the Pennsylvania, in 1837," was presented by Mr. John Lenthall, Naval Constructor U. S. N., and was read by Mr. J. C. Cresson.

Mr. L. prefaced the description of the launch with some remarks on the difficulties arising from the decayed state of the wharf at the Navy Yard, which rendered it necessary to rebuild the foundation of the ship after considerable progress had been made in her construction.

The building of the ship was commenced in the latter part of the year 1822, and she was launched in July, 1837, leaving Philadelphia in November of the same year.

Her dimensions are,—

Length at the upper deck, - - -	223 feet 7 inches.
Extreme breadth, - - - - -	58 „ 2 „
Height from lower side of the keel to the top of the rail, - - - - -	54 „ 8 „

Her armament will consist of 130 guns:

Lower gun deck,	4	8 inch Paixhan guns,	and 28	light 32 pounders.
Middle „	4	8 „ „	and 30	„
Upper „	8	8 „ „	and 22	„
Spar „	2	32 pound „	and 26	32 lb. carronades.

The total cost of this ship when she left Philadelphia, exclusive of the armament, was \$687,026, of which about \$535,000 was expended on the hull before she was launched.

The weight of the hull when she was launched was estimated at 2696 tons, of 2240 lbs.; the weight upon the bilge-ways being 2720 tons, including extra weights on board.

The inclination of the ways and of the keel, was 3° 31′, making the force down the plane $166\frac{46}{100}$ tons, and the pressure on the plane $2714\frac{33}{100}$ tons: allowing the friction to be 0.05 or $\frac{1}{20}$ the pressure, there was a tendency of $30\frac{73}{100}$ tons to cause the ship to descend the plane at the commencement of the motion.

The paper then proceeds to give a detailed description of the preparation of the launching and bilge-ways, and the methods adopted to give entire security to the immense structure when it should be put in motion; and gives the particulars of the dimension of the timbers, modes of fastening, &c., of much value and interest to practical men.

The immediate dispositions for the launch were begun at five o'clock on the morning of the 18th of July; and shortly after two in the afternoon, all the shores and blocks having been removed, the extended plank of the bilge-way which formed the last attachment of the vessel was sawed off. She did not move however, in consequence of the too great rigidity of the mixture with which the ways were greased, until an iron wedge had been driven into an opening made in the bilge-way plank by sawing out a small section, and an impetus was given by levers and suspended rams, which had been arranged in anticipation. Yielding readily to the force so applied, she entered the water at twenty minutes past two, without the slightest misadventure. Her draft of water was found to be eighteen feet seven inches aft, and fourteen feet ten inches forward.

Mr. Kane read a letter from the Rev. Professor Alonzo Potter, of Union College, Schenectady, N. Y., containing a brief reference to the career of Chancellor Livingston, and his useful labours in the cause of science and the arts. Professor Potter's letter was accompanied by an autograph letter of Count Rumford to Chancellor L., dated Auteuil, near Paris, 8th December, 1811, and a letter from Chancellor Livingston to Dr. De Witt, Secretary to the Society for Useful Arts, &c., dated Clermont, 26th November, 1806.

The following extracts are made from these:—

Count Rumford to Chancellor Livingston, 8th Dec. 1811.

I rejoiced to hear of the success which your steam-boats have had, and was glad to hear from yourself that the invention is likely to become extensively useful.

You have but one thing left to do; and that is, to establish a steam-wagon to carry passengers by land. I have not the least doubt of the practicability of the scheme, and do much expect to live long enough to see it executed. The machinery must be worked with strong steam, and no attempts must be made to condense it. As the resistance, on a flat road, will be very nearly the same with a swift motion as with a slow one, you might travel in this way with astonishing celerity, taking care to moderate the motion in turning corners. I imagine, that by making the wheels very high, and of cast iron, they might be made to act as flys, to equalize the distribution of the force. A fly of some kind or other would, I fancy, be indispensably necessary. Broad wheels and good roads would certainly be necessary.

Apropos of broad wheels: I send you enclosed a paper, in French, on that subject. I am quite sure they will come into fashion sooner or later, for all sorts of carriages. I use no other, and many persons are following my example in Paris and other places.

I send you another paper on lamps, which has made a more sudden revolution in this country. The portable lamps are now to be seen in several shops in Paris, and the lampe-à-colonne, for dining-tables and drawing-rooms, is in very general use. I wish I knew how to send you one of each of them. You will hear of another lamp soon, destined for light-houses, which gives just as much light as you please.

I have one, which with four flat wicks, each an inch and a half broad, placed at the distance of an inch from each other, with air coming up between them, gives as much light as fifty-two wax candles all burning together. By your consul, Mr. Russel, I lately sent an account of this new invention to the Royal Society, and from their transactions you will probably learn more of the matter in a few months.

I am just now employed in making a course of experiments on the quantities of heat produced in the complete combustion of various kinds of wood, and other inflammable substances.

Chancellor Livingston to Dr. De Witt, 26*th Nov.* 1806.

I forgot, when I had the pleasure of seeing you, to mention an invention which might, if perfected, be rendered of very general utility. While at Paris, I ordered a carriage for the purpose of trying it, but I was called away by the sailing of my ship before I could execute it. The object of it was to contrive some better springs for carriages than those now in use. Every body knows the utility of springs in saving the traveller from fatigue, and the carriage from being jolted to pieces in rough roads. But it is not so generally known, that they enable a horse to go through his work with much less fatigue; could they therefore be adapted to farming carts, they would be found extremely useful. The springs of carriages now in use are made either of wood or iron. The first is too weak or too clumsy; the last is not only expensive, but heavy and liable to rust, and above all to snap in very cold weather. Springs of either of these materials have one common and great inconvenience, that of not being able to adjust themselves to the different weights that are placed upon them. If they are so stiff as to bear a heavy burden, they have no elasticity under a light one; or if they spring under a small pressure, they break under a heavy one. This circumstance greatly limits their utility. For wood and iron I would therefore substitute the lightest, the cheapest, and the most elastic of all substances—air. This can never break, and its spring will always be proportioned to the weight that it acts upon. Place a carriage box upon the pistons of four brass tubes, each containing twenty inches of air. If these were four inches deep, it would require 295 lbs. to sink the pistons two inches, and four times that weight, or 1180 lbs., to sink them three inches, and upwards of a ton weight to bring them half an inch lower: in every case the spring would continue to act with a force proportionate to the pressure. If a greater motion in the spring is required, let the tubes be deeper. If eight inches deep, the motion, under equal pressure, will be the double of those I have mentioned. There are various ways in which these springs may be adapted to carriages. Of these, perhaps, the cheapest and the best would be two planks, united by leather dressed in oil, and covered with elastic gum, so as to be perfectly air-tight. For a chair, four bladders soaked in oil, and covered with strong leather in the way of a foot-ball, would make a cheap and excellent spring. The leathers should be put on before the bladders are blown up, and be somewhat smaller than the bladders, so as to press them strongly in every part; this would keep

them from breaking, or losing any air when strained. These balls should be confined in boxes that fit to their lower diameter, and over these the thorough braces that hold the chair should pass, and be fastened to the bars before and behind the chair. This would not only render such a carriage much lighter than those now in use, but by simplifying the machinery under it, also much cheaper. You will judge of the utility of my invention by an experiment I have already made. In travelling from Paris to Naples, we were three of us, with much baggage in my coach: my springs were English, and of the best quality: though we travelled post with six, and sometimes eight horses, over paved and broken roads, sometimes hard frozen, they never absolutely broke, but were constantly giving way: sometimes three or four plates would crack, sometimes the iron that supported them would break, and at other times they would tear and wreck the wood to which they were fastened: scarce a day passed that we were not compelled to have some repairs made, though we strengthened them with cords and thin slips of wood, as much as possible. On my return from Naples, they underwent a complete repair at Rome; the defective plates were taken out, and new ones put in; they were covered with wood, and the whole carefully corded; a precaution, without which no iron springs will stand travelling post a thousand or fifteen hundred miles; particularly as the postillions, instead of having any mercy upon them, do all in their power to break them. When they enter or leave a town or village, the pavement of which is extremely broken, they snap their whips in such a way as to bring all the inhabitants to their doors and windows, and put their horses upon full gallop, to show their address in driving. Before I got to Bologne, I found new repairs necessary, and I began to fear that no repairs would enable me to complete my journey through Germany with the same carriage. This determined me to try the following experiment:—

At Bologne they make foot-balls of asses' skin dressed in oil, and containing some oil to keep them supple. I purchased four of these, and after covering them with calf-skin, placed them between the two folds of the thorough braces, behind and before, where the screw springs are sometimes placed. These exceeded my expectation. Though I travelled in the months of February and March, when the roads were at their worst, through a considerable part of Italy, through the Tyrol and Germany, and through the paved roads of France by the way of Strasburgh to Paris, a journey of many hundred miles, not a spring gave way, nor did any part of the carriage

break; though I found before I arrived at Munich, that the air had escaped from one of the balloons that was placed under the front springs. The motion of the coach was also much easier than it had been before the application of the foot-balls.

Perhaps springs of this kind might be adjusted to saddles, so as to render the motion of a hard trotting horse as easy as that of a Narragansett. Air-cushions would be admirably adapted to the seat of the common Dutch wagon. These might, perhaps, be made out of the stomach of an ox or horse, well tanned and dressed in oil, and blown up to $1\frac{1}{2}$ atmosphere, or 22 lbs. pressure upon a square inch. Nor could a lighter or warmer coverlet for beds be contrived, than silk, rendered by elastic gum impenetrable to air, and stuffed with that material. I do not think it impossible even to make beds of it. And I sincerely wish it was effected, if it was only to relieve our poor geese from the horrible torture our luxury makes them undergo.

Professor W. A. Norton, of Delaware College, Newark, Del., presented and read a communication, entitled, "An Inquiry into the Constitution and Mode of Formation of the Tails of Comets."

The two distinct topics embraced in the title of this paper, were discussed in the order in which they are there named. In treating of the first topic, it was taken for granted, inasmuch as it is admitted by all astronomers, that the tail of a comet consists of the same kind of matter as the head; and accordingly is not a mere spectre of light, as some theorists have advocated. It was then argued, that the tail was formed from the matter of the nebulous envelope of the head: and in the same connexion it was incidentally established, that the particles of the tail could not revolve disconnectedly in separate parabolas, by showing that the tail would not on this supposition continue in the position of opposition to the sun; also that, supposing the particles to be connected in any way whatsoever, the situation of the tail could not be accounted for without taking into view the action of some force other than the sun's attraction.

Under the second head it was shown—1. That the sun is concerned, either directly or indirectly, in the process of forming the tail of a comet. 2. That the particles of matter which make up the tail, must have been driven off from the head by some force exerted in a direction from the sun. 3. That this force cannot ema-

nate from the nucleus. 4. That it must therefore be a force taking effect upon the matter of the comet from without, and from the sun outwards. 5. That it extends far beyond the earth's orbit, developing tails there as well as near the sun. It was inferred, from analogy, that this force decreased in receding from the sun. No attempt was made to investigate its nature; but since it acted precisely like a repulsive force, it was called, for the sake of simplicity of conception, the ***sun's repulsive force.*** Such being the force conceived to be the efficient cause of the development of the tail, there are two modes in which it may be supposed to act, viz.—1. By expelling a certain portion of nebulous matter into the form of a tail, which, being once fashioned, remains the same, revolving along with the nucleus until more matter chances to be driven off to add to its brightness and extent; which has been the received notion hitherto; or—2. By ***continually*** urging a portion of the cometic matter away from the head an indefinite distance into free space; in which case the tail, as seen by us at any instant, would be but the collection of all the particles that had been emitted from the head during a certain previous interval, viewed in the act of darting off into free space. This theory, so far as known, has not been propounded before by any astronomical writer. Agreeably to this notion, the tail increases in length towards the perihelion, by reason of a more copious evolution of shining nebulous matter, in consequence of the increased heat of the sun. It diminishes in brightness in receding from the head, and at last becomes too faint to be discerned, from the following causes:—1. A more rapid flow of the matter by reason of a longer continued action of the sun's repulsive force. 2. An increase in the breadth of the tail. This may be supposed to arise from the divergence of the lines of direction of the forces acting upon the outer parts of the envelope, and, in some cases also, from a rotation of the tail about its axis, generating a centrifugal force. The tails of some comets are known, from observation, to have had a motion of rotation about their axis, as the comets of 1769 and 1825, and Halley's comet at its last appearance. 3. An augmentation in the distance of the matter from the sun, the supposed source of its light.

The following objections were then urged against the received theory:—1. No good reason can be assigned why the sun's repulsive force, so called, should not drive off the nebulous matter of the tail still farther; since it extends indefinitely into space, and has sufficient energy to expel comparatively dense matter immediately from the nucleus of comets, that are more remote from the sun than the

extremities of the tails of the comets which have the smallest perihelion distances. 2. This being true, the repulsive force, which alone can be supposed to keep the tail in rotation so as to be always opposite to the sun, ought to dissipate it, rather than set it in rotation as one connected mass. 3. Agreeably to this theory, the tails of all comets that come near the sun, ought to be completely dissipated by the centrifugal force, in passing round this luminary; whereas no such fact has been observed. This was illustrated by the case of the comet of this year. It was shown, that on the supposition that the tail revolved with the nucleus, and at the same time rotated at such a rate as to keep opposite to the sun, the extremity of the tail must have had the amazing velocity of at least twenty-one thousand miles per second; that the centrifugal force must have been a hundred times greater than at the nucleus; and the gravitation towards the sun ten thousand times less.

It was next attempted to account for the phenomena of the situation of the tail, viz.—1. its general situation: 2. its deviation from the position of exact opposition to the sun, which is first perceived at a certain distance from the perihelion; after which it increases progressively until a short time after the perihelion passage, when it begins gradually to diminish, and finally becomes insensible: 3. the curvature of the tail. The first mentioned phenomenon is a simple consequence of the theory: the second also. It was shown, that the particles being driven away to any distance from the nucleus, still retaining their velocity in the direction parallel to the orbit, would at the end of any interval be in such situations, that the lines joining them with the nucleus would be parallel respectively to the radii-vectores, along which produced they were emitted from the nucleus; from which it followed, that the tail would deviate every where from the radius vector prolonged beyond the nucleus, and at the same time be curved and concave towards the regions of space which the comet has left. But this deviation would only be perceptible in the vicinity of the perihelion where the motion in anomaly was the most rapid. The smallness of the curvature throughout the greater part of the length of the tail, was explained by supposing that the velocity of emission soon came to be very great in comparison with that of the motion in anomaly. It was conceived, that the greater curvature at the extremity might arise from a diminished velocity of flow, by reason of the resistance of an ether in space, in conjunction with the falling back of the particles, in consequence of the resistance of the ether to the motion parallel to the orbit.

Finally, the objection to the theory that had been exposed, of a continual waste of the material of the tails, and a consequent gradual diminution in the length and brightness of these appendages, until at last they are wanting altogether, was considered. It was argued, that there were now many comets entirely devoid of tails, and that these may have already experienced the fate that is supposed to await all the others. Also, that multiple tails spring up suddenly, and then vanish in a few days. That the principal tail is more durable than these, because the stock of materials from which it is derived is larger, and is frequently supplied from vapour rising from the nucleus. The cases of Halley's comet and others were referred to in proof of this last assertion. It was added, that the waste here supposed was believed by many astronomers, from the results of observation, to be in actual progress.

Professor Draper presented a communication, entitled, "On the Decomposition of Carbonic Acid and the Alkaline Carbonates by the Light of the Sun," by John W. Draper, M.D., Professor in the University of New York City.

For many years it has been known that the green parts of plants, under the influence of the sunlight, possess the power of decomposing carbonic acid and setting free its oxygen. It is remarkable that this, which is a fundamental fact in vegetable physiology, should not have been investigated in an accurate manner. It is not known that any one has yet attempted an analysis of the phenomenon by the aid of the prism, the only way in which it can be truly discussed.

It is the object of Prof. D.'s paper to prove, 1st. That the light of the sun is the true cause of the decomposition, the rays of heat and the so called "chemical rays" not participating therein, as Graham, Johnston, and other writers on vegetable chemistry suppose. 2d. That it is the yellow light, or most luminous ray, that is mainly concerned. 3d. That leaves evolve not pure oxygen gas, but a mixture of oxygen and nitrogen in regulated proportions. 4th. That there is an extensive class of salts which is decomposed under the same circumstances, and therefore the phenomenon is rather to be attributed to a digestive than to a respiratory process. 5th. That this digestion is brought about in the same way as the digestion of animals, by the decay of a nitrogenized body.

To show that the light of the sun is the cause of the decomposition, having obtained a motionless spectrum by the aid of a heliostat,

he placed in the different coloured spaces tubes filled with water impregnated with carbonic acid gas, and containing some leaves of grass. The decomposition presently commenced, and in the course of two hours a sufficient quantity of gas was collected. On examination, it was found that the tubes in the yellow, the orange, and the green light, contained most gas; that in the red, a much smaller quantity; and those in the blue, the indigo, and the violet, none at all.

But the maximum of heat occurs in or beyond the red ray; the maximum of chemical action among the more refrangible colours, blue, indigo, and violet; and in these spaces the decomposition of the acid fails to go on.

From this he infers that it is the light of the sun, and the yellow light mainly, that is the cause of the phenomenon.

On causing leaves to decompose carbonic acid in water by the rays of the sun, and collecting the gas as it is evolved, it appears on no occasion to be pure oxygen, but a mixture of oxygen and nitrogen in variable proportions; from fifty to ninety per cent. of oxygen being found at different times, as is shown by explosion with hydrogen gas. But although there is this great variability in the proportion of the two gases evolved, a very simple law, which directs the progress of the decomposition, may be traced. On causing leaves to decompose a known volume of carbonic acid, the same volume of the mixed oxygen and nitrogen makes its appearance. From this it is to be inferred, that plants during this action do not only effect the fixation of carbon, as is commonly supposed, but with it they absorb a certain amount of oxygen also. When a leaf, exposed in carbonic acid gas to the sunshine, has completed its function, it has appropriated or assimilated all the carbon, and with it a certain portion of the oxygen; the residue of the oxygen has been evolved, and with it a volume of nitrogen precisely equal in amount to the volume of oxygen appropriated by the plant.

This disappearance of oxygen and appearance of nitrogen are thus connected with each other: they are equivalent phenomena.

The emission of nitrogen is not a mere accidental result, but is profoundly connected with the whole physiological phenomena.

The elementary conditions under which carbonic acid gas is decomposed having been thus stated, Prof. D. passed next to the description of similar decompositions occurring in the case of saline bodies. It has always been a subject of surprise to chemists, that the powerful affinity

which carbon and oxygen are thus held together, should be so easily overcome at common temperatures. Even potassium cannot decompose carbonic acid in the cold. It might therefore be reasonably expected, that the energetic forces which bring about this change ought also to effect other remarkable decompositions. In fact, the decomposition of carbonic acid is only one of a very numerous series.

Having boiled some distilled water to expel all gaseous matter, dissolve in it a small quantity of bicarbonate of soda. Introduce into a test tube some leaves of grass, fill the tube with the saline solution which has been once more boiled to expel any air it may have obtained from the dissolving salt, and invert the tube in some of the solution in a wine glass, after having carefully removed all adhering bubbles of air from the leaves by a piece of wire, or in any other convenient manner. This arrangement, kept in the dark, undergoes no change; but if brought into the sunshine, bubbles of gas are rapidly evolved, and in the course of a few hours the tube becomes half full. On detonation with hydrogen, this gas proves to be rich in oxygen.

Prof. D. made some attempts to discover how much oxygen could in this way be evolved from known quantities of bicarbonate of soda; supposing it probable that the second atom of carbonic acid being removed and decomposed, the process would cease: however, the results of his experiments indicated that the supposition he had formed was not correct. The process is not limited to the removal and decomposition of the second atom, but goes forward, the first itself being in like manner decomposed. From this it would seem that carbonate of soda itself should be decomposed; and experiment verified the conclusion: for on using that salt instead of the bicarbonate, the evolution of oxygen went on precisely in the same way.

As in these experiments a solid salt is decomposed, it is obvious that the function by which the leaves accomplish this is very different from that of respiration. It is not respiration, but a true digestion.

In the same way Prof. D. found that all kinds of soluble carbonates and several other organic salts, such as bitartrate of potash, citrate of soda, succinate of ammonia, &c., would emit oxygen.

It thus seems that the decay of some nitrogenized body in the leaf is essential to the digestive action of plants.

At this stage of the inquiry, a remarkable analogy appears between the function of digestion in animals and the same function in plants. Liebig has shown, how from the transformation of the tissues of the stomach itself, food becomes acted upon, and is turned into chyle, an obscure species of fermentation brought about by the decay of nitrogenized bodies. So in like manner in plants, the dissolution of a nitrogenized body brings about the assimilation of carbon. The facts seem to indicate, that the primary action of the light is not upon the carbonic acid, but upon the nitrogenized ferment; and that the decomposition of the gas occurs as a secondary result. From this we may infer that chlorophyll, the green colouring matter of leaves, is the body which in vegetables answers to the chyle of animals; that it is derived from the decomposed carbonic acid through the eremacausis of albumen brought into the leaf, or of some compound of the elements of ammonia that passes up by the route of the ascending sap; and that the oxygen which disappears, disappears to bring about the eremacausis of that ferment. Under this point of view, the digestion of plants may be regarded as taking place in the following way:—There is introduced into the leaf some azotized body formed by the aid of ammonia that has passed through the spongioles: on this the sunlight acts, bringing about its decomposition by causing its union with oxygen: and now, if carbonic acid be present, the decomposition is propagated to its atoms; a part of the oxygen set free is expended in continuing the eremacausis of the ferment; the rest is evolved with an equivalent volume of nitrogen. The carbon thus set free unites at once with the elements of water, and chlorophyll results. But this chlorophyll undergoes continuous change under the action of the sun, and is as continually replaced; from it is formed gum, and finally lignin, and all the woody fibre of plants must have originally existed as chlorophyll, or passed through the green stage.